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SOVIET RESEARCH IN THE FIELD OF SYNTHETIC RUBBER

G. A. Blokh

Soviet scientists have conducted significant research on synthetic latex. The most important work in this field was carried out by B. A. Dogadkin, V. L. Anokhin, and K. V. Berezan, B. Dolgoplosk, S. L. Talmud, A. I. Yurzhenko, S. S. Voyutskiy, and others (1). In the above works S. L. Talmud, Gol'ding, and Allokoshkin (2) showed that the formation of synthetic latex, or so-called emulsion polymerization, practically does not take place in the absence of oxygen, and that oxygen is the initiator of the reaction after entering the system with the starting materials.

The work of A. I. Yurzhenko is of great interest. It deals with a clarification of the mechanism of the formation of latex during emulsion polymerization.(3) Yurzhenko considers that the process of polymerization of hydrocarbons in emulsions takes place in the aqueous phase of micelles of emulsifiers. The role of the emulsifier is explained by its ability to disperse monomeric substances colloidally. For that reason, solid emulsifiers which do not possess this property do not promote polymerization. Increasing the concentration of the emulsifier leads to an increase of the number of micelles per unit of volume and is equivalent to an expansion of the zone of reaction.

The importance of the complex polymerization process is generally known. Prof B. A. Dogadkin and his co-workers (4) published several papers dealing with the kinetics of vulcanization and devoted to an explanation of the so-called "vulcanization optimum" for natural and synthetic rubber in the presence of small amounts (up to 3 percent) and large amounts (7 percent and above) of sulfur. These papers showed that the so-called vulcanization optimum, if a small quantity of sulfur is used for natural rubber, represents the result of two factors acting simultaneously, but in different directions, namely the reaction between the rubber and the vulcanizing agent and the reaction between the rubber and the molecular oxygen present in the rubber.

The vulcanizing agent performs the function of establishing the structure, connecting the molecular chains of the rubber into a complex spatial form, increasing the molecular weight and the general stability of the system. The

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molecular oxygen at a definite stage of the reaction with natural rubber finally causes a disintegration of the molecular chains, because destruction by oxidation takes place. With sodium butadiene rubber, as distinguished from natural rubber, the oxygen also acts as a structure-forming agent, combining, like sulfur, in a secondary reaction, the molecular chains into an extended structure. Thus in the vulcanization of sodium butadiene rubber, oppositely directed reactions of sulfur and oxygen are not observed.

The kinetic graphs show the vulcanization optimum as a function of the increase in tensile strength, swelling in benzene, and the amount of combined sulfur.

The credit for the development of oxygen (sulfurless) vulcanization goes to Soviet research.

The possibility of obtaining high-grade rubber without the use of sulfur was demonstrated by the work of A. D. Zoyonchkovskiy, G. A. Blokh, B. A. Safray, Kusov, Zhavoronok, Nemirovskiy, and others(5). Soviet research showed the possibility of using new vulcanizing agents, such as diazo amino benzene, quinones, nitro compounds, etc. Blokh and Zoyonchkovskiy obtained high-grade insulation materials, called thermoebonites, at high temperatures and without the use of sulfur.

The most important research was carried out in the leather-substitute industry, where manufacture is based on rubber and various synthetic resins. In this industry, economy of raw materials, primarily of virgin crude rubber, and its replacement by recovered rubber and fillers as part of the introduction of rational technology are of major importance. In this connection, the work of the Central Scientific Research Institute for Leather Substitutes on the composition of soles is of particular interest.

It is known that the industry has been employing new methods in the production of rubber components, e.g., the shaping process, in which various portions of the object are finished in various thicknesses to match the spatial distribution of wear, and the "pattern" process in which rubber mixtures of varying composition are used in the manufacture of an object. This improves the utilization characteristics of manufactured objects and at the same time permits economy in the use of rubber compositions and crude rubber.(6) During the last two years, about 70 percent of the soles produced for waterproof footwear were made by the shaping process(7). The process affords great economy in the use of crude rubber.

The work of Pisarenko and Emel'yanova is of great interest(8). It deals with the production of rubber-like materials on the basis of unsaturated compounds of plasticized rubber.

Soviet engineers have subjected established technological methods to thorough analysis. Thus, the engineers Arkhipov and Kormashkin introduced the production of rubber sole compositions with sulfur and accelerators in closed rubber mixers. This work will lead to a saving of 35 percent of electric power and reduce the requirements for rolling mill equipment and skilled labor.

Stalin Prize Laureate Koropol'tsev developed a method of casting rubber mixtures under pressure. Postnov developed a method of manufacturing rubber footwear by stamping.

These and other methods, developed by Soviet engineers, are fundamentally improving technology on the basis of new, advanced production principles.

In conclusion, we should like to point out the valuable work of the Stalin Prize Laureate V. I. Alekseyenko, who developed rational principles for the formulation of rubber sole compositions. The published work of his author (9) permits computation of formulas for rubber compounding on an exact quantitative basis.

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